WICHITA STATE UNIVERSITY

Program Review Self-Study Template

Academic unit: Industrial, Systems and Manufacturing Engineering

College: Engineering

Date of last review Fall 2015

Date of last accreditation report (if relevant) Fall 2013

List all degrees described in this report (add lines as necessary)

Degree: BS Industrial Engineering CIP* code: 14:35

Degree: BS Manufacturing Engineering CIP code: 14:36

Degree: MS Industrial Engineering CIP code: 14:35

Degree: MEM Engineering Management CIP code: 15:1501

Degree: PhD Industrial Engineering CIP code: 14:35

*To look up, go to: Classification of Instructional Programs Website, http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55

Certificate (s): _____

Faculty of the academic unit (add lines as necessary)

Name	Signature
Sandeep Nannapaneni (Assistant Professor)	
Laila Cure (Assistant Professor)	
Deepak Gupta (Associate Professor)	
Michael Jorgensen (Associate Professor)	
Krishna K Krishnan (Chair & Professor)	
Vis Madhavan (Professor)	
Ehsan Salari (Assistant Professor)	
Wilfredo-Moscoso Kingsley (Assistant Professor)	
Gamal Weheba (Professor)	
Mehmet Bayram Yildirim (Professor)	
Cindi Mason (Engineering Educator)	

Submitted by: Krishna K Krishnan (Chair & Professor) Date 4/16/18

(name and title)

In yellow highlighted

1. Departmental purpose and relationship to the University mission (refer to instructions in the WSU Program Review document for more information on completing this section).

a. University Mission:

The mission of Wichita State University is to be an essential educational, cultural, and economic driver for Kansas and the greater public good.

b. Program Mission (if more than one program, list each mission):

The mission of the BS in Industrial Engineering program is to prepare students through an experiential education to design, model, analyze, and manage modern complex systems in order to increase the effectiveness of manufacturing and service sector organizations.

The mission of the BS in Manufacturing Engineering program is to prepare students through an experiential education to design, model, analyze, and manage modern manufacturing materials and processes in order to increase the effectiveness of industrial organizations.

The mission of the MS in Industrial Engineering program is to enhance the skills of degreed engineers by providing advanced knowledge and skills that are needed to design, model, analyze and manage modern complex systems in order to increase the effectiveness of manufacturing and service sector organizations.

The mission of the Master's in Engineering Management program is to enhance the skills of degreed engineers which will increase their effectiveness in planning, decision making, complex problem solving, and managerial skills, while receiving advanced technical knowledge, in order to increase the effectiveness of manufacturing and service sector organizations.

The mission of the PhD program in Industrial Engineering program is to provide training education for degreed engineers to perform research and advance the knowledge in the areas of Systems Engineering, Manufacturing Engineering, and Ergonomics.

c. The role of the program (s) and relationship to the University mission: Explain in 1-2 concise paragraphs.

The role of the BS in Industrial Engineering program is to provide an undergraduate education to its students that will prepare the graduates to:

1. Be employed in jobs related to designing, modeling, analyzing, and managing modern complex systems, implementing and improving systems in manufacturing and service sectors at local, regional, national and global levels,
2. Pursue life-long learning, such as graduate studies and research, certification from professional organizations, Fundamentals of Engineering certification, or active participation in professional societies/activities.

3. Achieve professional success through the program's emphasis on applied learning through solving real world problems

The role of the BS in Manufacturing Engineering program is to provide an undergraduate education to its students that will prepare the graduates to:

1. Be employed in jobs related to design, model, analyze, and manage modern manufacturing materials and processes, implementation and improvement of systems in manufacturing in local, regional, national and global levels,
2. Pursue life-long learning, such as graduate studies and research, certification from professional organizations, Fundamentals of Engineering certification, or active participation in professional societies/activities.
3. Achieve professional success through the program's emphasis on applied learning through solving real world problems

The role of the MS in Industrial Engineering program is to provide a graduate education to its students that will prepare the graduates to:

1. Be employed in jobs related to design, model, analyze, and manage modern manufacturing materials and processes, implementation and improvement of systems in manufacturing and service sectors in local, regional, national and global levels. Pursue life-long learning, such as graduate studies and research, certification from professional organizations, FE/PE etc., and
2. Achieve professional success through the program's emphasis on applied learning through solving real-world problems.

The role of the Master's in Engineering Management program is to provide a graduate education to its students that will prepare the graduates to:

1. Be employed in jobs related to design, model, analyze, and manage modern manufacturing materials and processes, implementation and improvement of systems in manufacturing and service sectors in local, regional, national and global levels. Pursue life-long learning, such as graduate studies and research, certification from professional organizations, FE/PE etc., and
2. Achieve professional success through the program's emphasis on applied learning through solving real world problems.

The role of the PhD in Industrial Engineering program is to provide a graduate education to its students that will prepare the graduates to:

1. Be employed in jobs related to design, model, analyze, and manage modern manufacturing materials and processes, implementation and improvement of systems in manufacturing and service sectors in local, regional, national and global levels. Pursue life-long learning, such as graduate studies and research, certification from professional organizations, FE/PE etc., and
2. Achieve professional success through the program's emphasis on applied learning through solving real world problems.

The role and mission of the ISME department are consistent with the mission of the college of engineering and Wichita State University. There have been changes to the role statements for the BS, MS and PhD program in Industrial Engineering since the last assessment. All of them have been modified to include the applied learning mission of the university. Thus there is an emphasis on case studies and real world problem solving in the education of our graduates. This experience includes industry-based semester-long capstone design projects in

the undergraduate programs. Organizations such as: Girls Scouts of America, Red Cross, WSU Admissions Department, Office of Research Administration, and the local hospitals have also sponsored projects. At the graduate level, there will be more emphasis on industry based class projects.

d. Has the mission of the Program (s) changed since last review? ☐ Yes ☒ No
    i. If yes, describe in 1-2 concise paragraphs. If no, is there a need to change?

e. Provide an overall description of your program (s) including a list of the measurable goals and objectives of the program (s) (programmatic). Have they changed since the last review?
☐ Yes ☒ No
If yes, describe the changes in a concise manner.

Undergraduate Programs

The BS in Industrial Engineering program focuses on the design, analysis, improvement, and management of systems in manufacturing and service organizations. Industrial engineers bridge the gap between management and operations while emphasizing process improvement. Industrial engineers are unique in engineering as they also take into consideration the human element in the design of these systems. The department's BS in Industrial Engineering program includes 125 credit hours of required course work. The program is designed such that the students can complete their degree in 4 years. The program consists of general education, and required industrial engineering courses in the industrial engineering, and six 3-credit hour technical electives. The program offers three tracks for specialization: 1) Manufacturing, 2) Supply Chain & Analytics, and 30 Systems Engineering. The students also complete two industry-based senior design projects over the last two semesters of their study. The senior design projects are evaluated by industry and faculty.

The BS in Manufacturing Engineering (new name: Product Design and Manufacturing) program equips graduates with engineering methods, skills and experience required to develop and improve manufacturing processes and systems. The curriculum prepares graduates of this program to apply both deterministic and statistical analysis to identify problems and improve metrics such as productivity, quality, reliability, cost, waste, and sustainability. The department's BS in Manufacturing Engineering program includes 128 credit hours of required course work. The program is designed such that the students can complete their degree in 4 years. The program consists of general education, and required courses in industrial and manufacturing engineering, and four 3-credit hour technical electives. The students also complete a industry-based senior design project in the last semester. The senior design projects are evaluated by industry and faculty.

To achieve the PEOs, the department ensures that all BS in Industrial Engineering and BS in Manufacturing Engineering students demonstrate:

i. Engineering/Foundational Knowledge in mathematics, engineering sciences, applied probability, computer science, humanities, and social science
ii. Professional Skills to communicate in both oral and written forms and to be proficient in working in diverse teams of individuals
iii. IE Knowledge/Skills in designing, modeling, optimization, analysis, and evaluation of integrated systems of people technology, and information

iv. Confidence in Engineering and professional skills. (Measured through a confidence survey in senior design course)
v. Understanding of Professional and Ethical Behavior to be prepared for ethical decision making, service to the engineering profession, and have the means to continue in the acquisition of knowledge (

Both the BS in Industrial Engineering program and the Manufacturing Engineering program undergo continuous refinement with input from faculty, students, alumni, and the Industrial Advisory Board. The Program Educational Objectives (PEOs) were refined in 2016 based on recommendations from the Industrial Advisory Board in consultation with the department constituents. The curriculum, lab development and other educational opportunities are analyzed and structured to meet the PEOs of the programs. The PEOs were refined to address the department's expanded focus on applied learning.

Graduate Programs

The Master of Science in Industrial Engineering (MSIE) degree program prepares students for research and design in the areas of Systems Engineering, Manufacturing Engineering, and Ergonomics. Students can complete the degree requirement through any of the following options: thesis, directed project, or all coursework. For the thesis option – the students must complete a minimum of 24 credit hours of coursework (consisting of core courses, major area courses, and technical electives) along with 6 credit hours of research (thesis). The students present a proposal for their research at least 3 months prior to the formal defense of their research work. For the directed project option - the students complete a minimum of 30 credit hours of coursework (consisting of core courses, major area courses, and technical electives) along with 3 credit hours of research (directed project). A formal oral presentation is required to defend and complete the MS project. For the coursework option – the students complete a minimum of 33 credit hours of coursework (consisting of core courses, major area courses, and technical electives). The students complete a terminal activity which can be either a one credit hour project at a local company or a certification from an external agency as part of the degree requirements.

The department ensures that all MS in Industrial Engineering students have:

1. the technical knowledge in the field of industrial and/or manufacturing engineering and professional skills to get employment and to advance in their field
2. the knowledge and academic background necessary to be accepted to other advanced degree programs
3. the ability to communicate effectively via technical papers and presentations

The Master's in Engineering Management (MEM) degree program is directed towards helping engineers develop planning, decision making, complex problem solving, and managerial skills while receiving advanced technical knowledge. The MEM program is structured for practicing technical professionals to enhance their breadth of knowledge in their specific field into management and business. The MEM program consists of a minimum of 36 credit hours of course work.

The department ensures that all Master's in Engineering Management students have:

1. the technical knowledge in the field of industrial engineering and management and professional skills to get employment and to advance in their field
2. the ability to communicate effectively via technical papers and presentations

The PhD in Industrial Engineering program is directed towards training students to perform research and advance the knowledge in the areas of Systems Engineering, Manufacturing Engineering, and Ergonomics. The PhD program offers tracks in all of the three areas described above. The PhD program consists of an additional 30 credit hours work beyond MS and 24 credit hours of research. The students present a proposal for their research at least 6 months prior to the formal defense of their research work.

The department ensures that all PhD in Industrial Engineering students have:

1. a solid background, technical knowledge in the field of Industrial and/or Manufacturing Engineering, and professional skills to get employment and to advance in their field
2. the knowledge, professional skills, and good publication record in their research area to get employment in academic positions
3. the ability to communicate effectively via technical papers and presentations

2. Describe the quality of the program/certificate as assessed by the strengths, productivity, and qualifications of the faculty in terms of SCH, majors, graduates, and scholarly/creative activity (refer to instructions in the WSU Program Review document for more information on completing this section).

Scholarly Productivity	Number Journal Articles		Number Presentations		Number Conference Proceedings		Performances			Number of Exhibits		Creative Work		No. Books	No. Book Chaps.	No. Grants Awarded or Submitted	$ Grant Value
	Ref	Non-Ref	Ref	Non-Ref	Ref	Non-Ref	*	**	***	Juried	****	Juried	Non-Juried				
Year 1 (2015)	23			19	15											7	1061387
Year 2 (2016)	20			21	8											7	1786123
Year 3 (2017)	13			19	9											5	781552

* Winning by competitive audition. **Professional attainment (e.g., commercial recording). ***Principal role in a performance. ****Commissioned or included in a collection.

The student credit hour production has been increasing steadily over the last 3 years. For 2016, the SCH production is 3380. This averages to 338/FTE position which is much larger than the university average of 216.The undergraduate program numbers are increasing. However, the graduate numbers has shown a slight decrease, primarily because of loss of students from India and other countries. The degree production for PhD is healthy with 8 , 7 and 10 graduates for 2015, 2016, and 2017 respectively. The BS degree production has also increased steadily.

- Provide a brief assessment of the quality of the faculty/staff using the data from the table above and tables 1-7 from the Office of Planning Analysis as well as any additional relevant data. Programs should comment on details in regard to productivity of the faculty (i.e., some departments may have a few faculty producing the majority of the scholarship), efforts to recruit/retain faculty, departmental succession plans, course evaluation data, etc.

There are 11 faculty (10 FTE) in the IME department. The 10 FTE positions include one faculty who chairs the Biomedical Engineering Department. All 11 faculty support the MS in Industrial Engineering program and the PhD in Industrial Engineering Program. The Master's in Engineering Management is supported by 5 faculty. The department has made offers to 2 more tenure-track faculty (who have accepted and will join the department in Fall 2018). We have increased the number of faculty in manufacturing engineering to 3 (one new faculty). In addition, adjuncts with expertise in appropriate areas are hired to teach on a regular basis to support the programs. The department lost two NSF Career award grantees in 2017, which has impacted the number of publications and new grant awards in 2017. The addition of new faculty is expected to get the department back on increased research grants and journal papers.

3. **Academic Program/Certificate: Analyze the quality of the program as assessed by its curriculum and impact on students for each program (if more than one). Attach updated program assessment plan (s) as an appendix (refer to instructions in the WSU Program Review document for more information).**

a. For undergraduate programs, compare ACT scores of the majors with the University as a whole.
For Industrial Engineering, the ACT scores for the past three rolling 5-years are 23.9, 23.9, and 24. The ACT scores are better than the university averages by about 0.9 in each of the years.
For Manufacturing Engineering, the ACT scores for the past three rolling 5-years are 23.5, 22.9, and 22.9. The ACT scores are similar to the university averages.

b. For graduate programs, compare graduate GPAs of the majors with University graduate GPAs.
For Industrial Engineering, the GPAs for the past three rolling 5-years are 3.4, 3.4, and 3.3. The GPAs are very similar to the university averages.
For Engineering Management, the incoming GPAs for the past three rolling 5-years are 3.3, 3.3, and 3.2. The GPAs are slight lesser than the university averages.

c. Identify the principal learning outcomes (i.e., what skills does your Program expect students to graduate with). Provide aggregate data on how students are meeting those outcomes in the table below. Data should relate to the goals and objectives of the program as listed in 1e. Provide an analysis and evaluation of the data by learner outcome with proposed actions based on the results.

In the following table provide program level information. You may add an appendix to provide more explanation/details. Definitions:
Learning Outcomes: Learning outcomes are statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their matriculation through the program (e.g., graduates will demonstrate advanced writing ability).
Assessment Tool: One or more tools to identify, collect, and prepare data to evaluate the achievement of learning outcomes (e.g., a writing project evaluated by a rubric).
Criterion/Target: Percentage of program students expected to achieve the desired outcome for demonstrating program effectiveness (e.g., 90% of the students will demonstrate satisfactory performance on a writing project).
Result: Actual achievement on each learning outcome measurement (e.g., 95%).
Analysis: Determines the extent to which learning outcomes are being achieved and leads to decisions and actions to improve the program. The analysis and evaluation should align with specific learning

outcome and consider whether the measurement and/or criteria/target remain a valid indicator of the learning outcome as well as whether the learning outcomes need to be revised.

Learning Outcomes (most programs will have multiple outcomes)	Assessment Tool (e.g., portfolios, rubrics, exams)	Target/Criteria (desired program level achievement)	Results	Analysis

.Details for all programs are given below:

Each course in the Industrial and Manufacturing Engineering department has clearly identified learner outcomes communicated in the syllabus.

Undergraduate Programs

At the undergraduate level, the Accreditation Board for Engineering and Technology (ABET) criterion are used as part of assessment. Based upon the ABET accreditation process, the student learning outcomes are assessed by measuring and ensuring that each undergraduate student in the BS in Industrial Engineering program has:

a. An ability to apply math, science, and engineering knowledge
b. An ability to design/conduct experiments as well as to analyze and interpret data
c. An ability to design system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. An ability to function on multi-disciplinary teams
e. An ability to identify, formulate, and solve engineering problems
f. An understanding of professional and ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and social context
i. A recognition of the need for, and an ability to engage in life-long learning
j. A knowledge of contemporary issues
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

In order to assess the full range of ABET learning outcomes; assessments were allocated to specific courses. The allocations are made such that each outcome was assessed in multiple courses and each core course assessed multiple outcomes, Table 1.

Table 1 Allocation of ABET a-k student outcomes to specific required courses for the Industrial Engineering program.

Course Coordinator	DM	MJ	BY	LW	GW	JT	KK	JT	VM	DM	
IE											
Program Outcome	452	549	550	553	554	556	563	565	258	Sr Design	Mean
a. Apply Math/Science /Engineering Knowledge			X	X						X	X
b. Design/conduct experiments		X			X			X		X	X
c. Design system/comp.	X						X			X	X
d. Function on teams									X	X	X
e. Solve Engr. Problems	X		X				X			X	X
f. Professional/ethical responsibility		X								X	X
g. Communicate	X					X		X		X	X
h. Global/Social Context				X						X	X
i. Life-long learning					X					X	X
j. Contemporary Issues		X		X						X	X
k. Engineering Practice			X							X	X
IE 1. Develop, implement, and improve integrated systems	X	X	X	X						X	X
IE 2. Integrate systems using appropriate analytical, computational, and experimental practice					X	X	X			X	X

A sample format of the data assessment is shown in Table 2. Table 2 shows that each learning outcome is assessed multiple times in multiple forms in this course. The performance is the ratio of points earned to total point available for the specific measure.

Table 2 An example of learning outcome assessment assigned to a specific course.

Similar assessments are made for the identified courses each semester.

Specific assessment instrument	Program Outcome Assessed (a-k)					
	c		d		1	
	Earned	Out of	Earned	Out of	Earned	Out of
Quiz #1			15	20		
Exam #1 (2 Questions)			26	30		
Project #1	37	50	37	50		
Project #2	32	50				
Exam #2 (1 Question)	12	15	12	15		
Quiz #4	16	20				
Term Project	78	100				
Exam #3 (3 Questions)	24	30				
All Individual Assessments					532	650
Column Total	199	265	90	115		
Program Outcome Assessment (0-100%)	75.1		78.3		81.2	

An identical process is used to assess learning outcomes for the Manufacturing Engineering program with a change in the program specific outcomes at the end of the list.

Based upon the ABET accreditation process, the learning outcomes are assessed by measuring and ensuring that each undergraduate student in the BS in Manufacturing Engineering Industrial Engineering program has:

a. An ability to apply math, science, and engineering knowledge
b. An ability to design/conduct experiments as well as to analyze and interpret data
c. An ability to design system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. An ability to function on multi-disciplinary teams
e. An ability to identify, formulate, and solve engineering problems
f. An understanding of professional and ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and social context
i. A recognition of the need for, and an ability to engage in life-long learning
j. A knowledge of contemporary issues
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Table 3 illustrates the allocation of ABET outcome to program assessment learning outcomes for the 2017 academic year.

Table 3. The allocation of a-k Student Outcomes to specific required courses for assessment.

Student Outcome	Work Sys 452	Ind Ergo 549	Ops Res 550	Prod Sys 553	SQC 554	Info Sys 556	Fac Des 563	Sys Sim 565	Mfg Pro 258	Sr Dsgn	Mean
a. Apply mathematics/science/ engineering knowledge			X	X						X	
b. Design/conduct experiments		X			X	X		X		X	
c. Design system/component	X						X			X	
d. Function on teams									X	X	
e. Solve engineering problems	X		X				X			X	
f. Demonstrate professional/ ethical responsibility		X								X	
g. Communicate	X					X		X		X	
h. Demonstrate understanding in global/social context				X						X	
i. Recognize life-long learning					X					X	
j. Know contemporary issues		X		X						X	
k. Demonstrate ability to practice engineering										X	

Feedback Loop:

In addition to the ABET based outcome assessment, some courses conduct a prerequisite assessment to assess the skills of incoming students. There is also a core competency exam administered to each graduating senior, an assessment by a panel of each capstone design project, and an anonymous exit survey assessing student perceptions of their abilities and the quality of their educational experience. The department's Curriculum and Assessment Committee assesses the results of the measures and may perform additional studies. Issues are identified and recommendations made to the faculty meeting as a committee of a whole. These assessments are the basis for the continued development of a more effective faculty.

Criterion /Target for assessment

The target level for achievement is set at 80% for individual ABET outcomes as well as for the learning outcomes identified for the program. The target level is reviewed by the department curriculum committee periodically. The 80% value was chosen based upon the nature of the individual items used in courses as the basis for assessment. These are typically items that are very discriminating in terms of competency and thus

do not include the easier elements that may makeup some elements of homework assignments or some test questions.

However, the department is currently in the processing of revising the learning outcomes and the courses from which the learning outcomes data are collected. ABET the accreditation organization. This is because of the changes in the learning outcomes prescribed by the accreditation organization.

The new ABET learning outcomes for undergraduate engineering programs are given below. They have listed learning outcomes as 1 through 7:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

In Spring 2018, the department has been working on the assignment of the learning outcomes to the courses in Industrial Engineering and Manufacturing Engineering. The assignment of learning outcomes to courses are given in Table 4 and Table 5 for the Industrial Engineering and Manufacturing Engineering Program.

Table 4. Future Allocation of ABET 1-7 student outcomes to specific required courses for the BSIE program.

Course Coordinator		BY	LC	MJ	ES	LC	GW	ES	KK	KK/RA	VM/WM	CM
Program Outcome	Phil 385	255	452	549	550	553	554	556	563	565	258	Sr Des
1			X		X	X		X	X	X	X	X
2		X		X					X			X
3			X					X	X		X	X
4	X	X		X					X			X
5						X			X		X	X
6			X	X		X	X			X		
7			X		X				X			X

Table 5. Future Allocation of ABET 1-7 student outcomes to specific required courses for the BSMfg E program.

Course Coordinator		BY	LC	MJ	ES	LC	GW	ES	KK	KK/RA	VM/WM	CM
Program Outcome	Phil 385	255	553	554	258	676	361	410	558	425	625	Sr Design
1			X		X		X	X	X	X	X	X
2		X			X	X			X		X	X
3					X	X			X			X
4	X	X			X				X		X	X
5			X		X				X			X
6			X	X					X		X	
7					X				X		X	X

Graduate Programs

The goals of the MS in Industrial Engineering program is to ensure that graduates have:

1. the technical knowledge in the field of industrial and/or manufacturing engineering and professional skills to get employment and to advance in their field (measured by learner outcomes – i, iii and iv)
2. the technical knowledge, and academic background necessary to be accepted to other advanced degree programs (measured by learner outcomes – i, iii, and iv)
3. the ability to communicate effectively via technical papers and presentations(measured by learner outcomes – ii)

The MS in Industrial Engineering program goals is assessed on an annual basis using the following measures:

1. At least 80% of the MSIE graduates will be employed or admitted to another advanced degree program in six months after graduation
2. Program goals 1 and 2 will also be assessed through the graduate curriculum using learner outcomes i, iii, iv, and v.
3. Program goal 2 will also be measured through publications resulting from research.

Learner outcomes and assessment details for the MS in Industrial Engineering are provided in Table 6. . The results indicate that IME graduate students achieve the learner outcomes above the target 80% level in all five learner outcomes.

Table 6. Learner outcomes and assessment for the MS in Industrial Engineering

Learner Outcome	Assessment Tool	Target/Criterion	Result
i) Graduates will have an ability to self-educate.	-rubric score on MS project or MS thesis -research projects in courses	80%	 80.1%
ii) Graduates will communicate effectively	writing skills - via assignments and projects in the required technical writing class CESP750D; graduate level courses that have writing component; and thesis or project Presentation skills - via graduate level courses that have presentation component; and thesis or project	80%	 84.6%
iii) Graduates will be able to design and improve systems, components, or processes to meet desired needs	Graduates will be assessed for course learner outcomes while taking classes which emphasize design and improvement of engineering systems.	80%	 88.5%
iv) Graduates will have knowledge of professional and ethical responsibility	Graduate students will be assessed using Collaborative Institutional Training Initiative CITI integrity modules supported through the Office of Research Administration	80%	100%

The goals of the Master's in Engineering Management program is to ensure that graduates have:

1. the technical knowledge in the field of Industrial and Management and professional skills to get employment and to advance in their field (measured by learner outcomes i, iii, and iv)
2. the ability to communicate effectively via technical papers and presentations (measured by learner outcome ii)

The Master's in Engineering Management program goals are assessed on an annual basis using the following measures:

1. At least 80% of the graduates will be employed six months after graduation
2. Program goal 1 will also be assessed through the graduate curriculum using learner outcomes i, iii, iv, and v.

Learner outcomes and assessment details for the Master's in Engineering Management program are provided in Table 7. The results indicate that IME graduate students achieve the learner outcomes above the target 80% level in all five learner outcomes.

Table 7. Learner outcomes and assessment for the Master's in Engineering Management Program

Learner Outcome	Assessment Tool	Target/Criterion	Result
i) Graduates will have an ability to self-educate.	research projects in courses	80%	80.1%
ii) Graduates will communicate effectively	writing skills - via assignments and projects in the required technical writing class CESP750D; and graduate level courses that have writing component Presentation skills - via graduate level courses that have presentation component	80%	84.6%
iii) Graduates will be able to design and improve systems, components, or processes to meet desired needs	Graduates will be assessed for course learner outcomes while taking classes which emphasize design and improvement of engineering systems.	80%	88.5%
iv) Graduates will have knowledge of professional and ethical responsibility	Graduate students will be assessed using CITI integrity modules with average scores reported	80%	100%

The goals of the PhD in Industrial Engineering program is to ensure that graduates have:

1. a solid background, technical knowledge in the field of Industrial and/or Manufacturing Engineering, and professional skills to get employment and to advance in their field a solid Industrial and/or Manufacturing Engineering background, technical knowledge and professional skills to get employment and to advance in their field
2. the knowledge, professional skills, and good publication record in their research area to get employment in academic positions
3. the ability to communicate effectively via technical papers and presentations

The PhD in Industrial Engineering program goals are assessed on an annual basis using the following measures:

1. At least 80% of the PhD graduates will be employed six months after graduation
2. Program goals 1 and 2 will also be assessed through the graduate curriculum using learner outcomes i, iii, iv, and v.
3. Program goal 3 will also be measured through publications resulting from dissertation research.

Learner outcomes and assessment details for the PhD in Industrial Engineering program are provided in Table 8. The results indicate that IME graduate students achieve the learner outcomes above the target 80% level in all four learner outcomes.

Table 8. Learner outcomes and assessment for the PhD in Industrial Engineering (n=21)

Learner Outcome	Assessment Tool	Target/Criterion	Result
i) Graduates will have an ability to self-educate and do independent research	-rubric score on dissertation -research projects in courses	80%	84.6%
ii) Graduates will communicate effectively writing and presentation	writing skills via assignments and projects in the required technical writing class CESP750D; graduate level courses that have writing component; and dissertation -Presentation skills via graduate level courses that have presentation component; and dissertation defense	80%	92.3%
iii) Graduates will have competency in core, major and minor areas	Average scores from qualifying exam. Will require dissertation chair to report a numerical score; -graduates will be assessed via prerequisite quizzes in the classes which utilize the concepts developed in the core classes.	80%	100%
iv) Graduates will be able to design and improve systems, components, or processes to meet desired needs	Graduates will be assessed for course learner outcomes while taking classes which emphasize design and improvement of engineering systems.	80%	84.6%
v) Graduates will have knowledge of professional and ethical responsibility	Graduate students will be assessed using CITI integrity modules with average scores reported	80%	100%

In the following table, a summary of publications by our students is given:

Table 9. Graduate Student Activity

	2015	2016	2017
Graduate Student Co-Authored Journal Publications	21	20	13
Graduate Student Co-Authored Conference Publications	14	8	9
IIE/INFORMS Poster Presentations	16	20	18

The data clearly indicates that IME graduate students have been very active in dissemination of research through journal and conference papers, and presentations.

Feedback Loop:

1. Results of the exit survey by the graduate school are used to identify additional needs and suggestions. The graduate school exit survey will be used to enhance faculty availability and attitude.
2. The departmental graduate committee will review the program outcomes and requirements each semester and recommend changes. Data collection on corrective action will be performed by the graduate committee.

Provide aggregate data on student majors satisfaction (e.g., exit surveys), capstone results, licensing or certification examination results (if applicable), employer surveys or other such data that indicate student satisfaction with the program and whether students are learning the curriculum (for learner outcomes, data should relate to the outcomes of the program as listed in 3c).

The three rolling average of “percent satisfied or very satisfied” is 78.9% and 45.5% respectively for the Industrial Engineering and Manufacturing Engineering programs (Table 10) . The lower number with the manufacturing engineering program is possibly a result of lack of faculty in the area. We have added one more faculty to the area for Fall 2018. All other measures are in the 80 – 90 % area.

Learner Outcomes (e.g., capstone, licensing/certification exam pass-rates) by year, for the last three years				
Year	N	Name of Exam	Program Result	National Comparison±
1				
2				
3				

A summary of results of the exit survey for undergraduates from 2015-2017 is presented in Table 10. The results indicate that at least 80% of the graduates are satisfied with the graduate programs.

Table 10. Undergraduate Student Survey Results

Exit Interview Question	BSIE	BSMfgE
Program provided material on Requirements	97.2%	90.9%
Faculty well informed on program requirements	91.5%	81.8%
Faculty were accessible	95.8%	81.8
Overall satisfaction with the program (satisfied or higher)	78.9%	45.5%
Courses offered at Convenient times	73.2%	54.5%
Enrolled in online courses	46.5%	18.2%
Satisfaction w faculty on feedback on course work	76.1%	18.2%
Satisfaction with quality of instruction	83.1%	27.3%
Received academic advising before enrolling	93.0%	90.9%
Academic advisor informed on degree requirements	88.7%	90.7%
Academic advisor made degree requirements clear	85.9 %	72.7%
Academic advisor help select courses	88.7%	72.7%
Academic advisor notified me of grad deadlines	69.0%	63.6%
Satisfaction with academic advising	80.3%	45.5%
Competent in Oral/Written Communication (4 or higher)	85.9%	90.9%
Competent in numerical litearcy	84.5%	81.8
Competent in critical thinking	85.9	81.8%
Competent in team work	84.5%	72.7%
Competent in diversity	74.6%	45.5%
Participated in Co-op	43.7%	45.5%
Usefulness of Co-op	93.5%	80%
Participated in Internship	40.8%	45.5%
Usefulness of Internship	100%	100%
Academic background useful in career	87.3%	72.7%
Higher degree open job opportunities	100%	100%
Job related to degree	83.3%	75en%

In general, MSIE, MEM and PhD students are very satisfied with the course offering. The MEM courses have been changed to be more flexible from Fall 2018 onwards. This is expected to increase the satisfaction with course offerings.

IME graduate committee will continue to meet to discuss a) how the quality of IME graduate programs could be improved, and b) new interdisciplinary programs.

A summary of results of the exit survey for graduate students is presented in Table 11. The results indicate that at least 80% of the graduates are satisfied with the MEM program and more than 90% are satisfied with the graduate IE programs.

Table 11. Graduate Student Survey Results

Exit Interview Question	MEM	MSIE
Program provided material on Requirements	97.2%	98.3%
Faculty well informed on program requirements	97.2%	97.2%
Faculty were accessible	91.7%	98.3%
Overall satisfaction with the program (satisfied or higher)	80.6%	90.5%
Courses offered enabled timely degree completion	86.1%	93.3%
Enrolled in online courses	47.2%	26.8%
Satisfaction w faculty on feedback on course work	38.9%	49.2%
Satisfaction with quality of instruction	86.1%	85.5%
Received academic advising before enrolling	86.1%	95.5%
Academic advisor informed on degree requirements	97.2%	96.6%
Academic advisor made degree requirements clear	88.9%	92.2%
Academic advisor help select courses	86.1%	88.8%
Academic advisor notified me of grad deadlines	72.2%	88.3%
Satisfaction with academic advising	66.7%	87.7%
Research advisor accessible	66.7%**	97.9%
Research advisor advise on defense prep	66.7%**	98.9
Satisfaction with research advisor	66.7%**	88.9%
Usefulness of academic program for career	86.1%	84.4%

** -Not applicable, since MEM students do not do research.

In general, MSIE, MEM and PhD students are very satisfied with the course offering. The MEM courses have been changed to be more flexible from Fall 2018 onwards. This is expected to increase the satisfaction with course offerings.

IME graduate committee will continue to meet to discuss a) how the quality of IME graduate programs could be improved, and b) new interdisciplinary programs.

d. Provide aggregate data on how the goals of the *WSU General Education Program* and *KBOR 2020 Foundation Skills* are assessed in undergraduate programs (optional for graduate programs).

Outcomes: ○ Have acquired knowledge in the arts, humanities, and natural and social sciences ○ Think critically and independently ○ Write and speak effectively ○ Employ analytical reasoning and problem solving techniques	Results	
	Majors	Non-Majors

Note: Not all programs evaluate every goal/skill. Programs may choose to use assessment rubrics for this purpose. Sample forms available at: http://www.aacu.org/value/rubrics/

From the exit survey results for undergraduate students (Table 10), it can be seen that the graduates are confident about their oral/written communication, numerical literacy, team work and critical thinking. The students are also assessed on oral/written communication skills. Team work and numerical literacy through several courses in the IME curriculum.

e. For programs/departments with concurrent enrollment courses (per KBOR policy), provide the assessment of such courses over the last three years (disaggregated by each year) that assures grading standards (e.g., papers, portfolios, quizzes, labs, etc.) course management, instructional delivery, and content meet or exceed those in regular on-campus sections.
Provide information here:

f. Indicate whether the program is accredited by a specialty accrediting body including the next review date and concerns from the last review.
The BSIE and BS in Manufacturing Engineering are accredited by ABET.

g. Provide the process the department uses to assure assignment of credit hours (per WSU policy 2.18) to all courses has been reviewed over the last three years.

New courses

 In the process of developing a new course, faculty propose the appropriate assignment of credit hours to a course on the Curriculum Change Form (CCF).

 The proposed assignment of credit hours is submitted to the following administrators and committees, in sequential order, for review and approval:

1. Department Chair;
2. College Curriculum Committee; and
3. Dean of the College;

Existing courses

 In the process of scheduling existing courses, meeting hours in compliance with the WSU policy 2.18 and per the approved CCF is scheduled by the department chair.

 The hours of scheduled courses are reviewed by member of the departmental curriculum committee and chair in each semester before it is available to students for registration.

h. Provide a brief assessment of the overall quality of the academic program using the data from 3a – 3e and other information you may collect, including outstanding student work (e.g., outstanding scholarship, inductions into honor organizations, publications, special awards, academic scholarships, student recruitment and retention).

There are 11 faculty (10 FTE) in the IME department. The 10 FTE positions include one faculty who chairs the Biomedical Engineering Department. All 11 faculty support the MS in Industrial Engineering program and the PhD in Industrial Engineering Program. The Master's in Engineering Management is supported by 5 faculty. The department has made offers to 2 more tenure-track faculty (who have accepted and will join the department in Fall 2018). We have increased the number of faculty in manufacturing engineering to 3 (one new faculty). In addition, adjuncts with expertise in appropriate areas are hired to teach on a regular basis to support the programs. The department lost two NSF Career award grantees in 2017, which has impacted the number of publications and new grant awards in 2017. The addition of new faculty is expected to get the department back on increased research grants and journal papers.

The grad program enrollment is one the highest in the Midwest for IE programs. The undergraduate program has also been steadily increasing. The demand for IE and manufacturing engineers are also high. The overall satisfaction with the programs is strong for both undergraduate and graduate programs.

4. Analyze the student need and employer demand for the program/certificate. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

a. Evaluate tables 11-15 from the Office of Planning Analysis for number of applicants, admits, and enrollments and percent URM students by student level and degrees conferred.

b. Utilize the table below to provide data that demonstrates student need and demand for the program.

Employment of Majors*							
	Average Salary	Employ-ment % In state	Employment % in the field	Employment: % related to the field	Employment: % outside the field	No. pursuing graduate or profes-sional educa-tion	Projected growth from BLS** Current year only. Median Salary - $85,880 Projected growth – 10%
Year 1							
Year 2							
Year 3							

* May not be collected every year

** Go to the U.S. Bureau of Labor Statistics Website: http://www.bls.gov/oco/ and view job outlook data and salary information (if the Program has information available from professional associations or alumni surveys, enter that data)

- Provide a brief assessment of student need and demand using the data from tables 11-15 from the Office of Planning and Analysis and from the table above. Include the most common types of positions, in terms of employment graduates can expect to find.

The Bureau of labor & statistics predict a 10% growth in the profession from 2016 – 2026. The demand is steady and and has a healthy demand compared to other engineering professions. This is also validated by the fact that almost all of our undergraduates (US Citizens) have their first intership opportunity by Juior year.

5. **Analyze the service the Program/certificate provides to the discipline, other programs at the University, and beyond. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).**

The student credit hour (SCH) generation by the faculty has been increasing steadily. Almost 50% of the SCH generated is for non-IE majors. As the number of students enrolled in the ISME programs are increasing, the percentage is shifting more towards IE and Mfg Majors.

a. Provide a brief assessment of the service the Program provides. Comment on percentage of SCH taken by majors and non-majors, nature of Program in terms of the service it provides to other University programs, faculty service to the institution, and beyond.

Several of the courses attract students from other engineering majors as well. Almost 50% of the credit hours generated cater to non ISME majors.

The IME department also has a policy of open lab usage to all units across the campus. Thus we provide assistance to all units on campus with respect to the manufacture and prototype work. This has allowed students and faculty from all departments being helped in their course work and research work. For example, the department has manufactured prototypes for aerospace engineering program, mechanical engineering, chemistry department, biomedical engineering, etc.

6. Report on the Program's/certificate's goal (s) from the last review. List the goal (s), data that may have been collected to support the goal, and the outcome. Complete for each program if appropriate (refer to instructions in the WSU Program Review document for more information on completing this section).

(For Last 3 FYs)	Goal (s)	Assessment Data Analyzed	Outcome
	Increase experiential learning/applied learning	Plans in plans to ensure that 100% of students that attend WSU ISME programs will have learning experience	
	New hybrid models of teaching	HYB & HYO classes have increased	
	Lab & problem based learning to be increased	Added new labs for IME 452, and projects in several courses	
	Inter-disciplinary efforts		MS in Global Supply Chain Management with Business School
	Increase research funding	Was on track; however with some faculty leaving – this year is back to rebuilding	
	Development of centers/labs	Two new labs developed	One for adfvanced manufacturing and another for work systems

7. Summary and Recommendations

a. Set forth a summary of the report including an overview evaluating the strengths and concerns. List recommendations for improvement of each Program (for departments with multiple programs) that have resulted from this report (relate recommendations back to information provided in any of the categories and to the goals and objectives of the program as listed in 1e). Identify three year goal (s) for the Program to be accomplished in time for the next review.

Enrollment has continued to increase steadily. To continue with the strong enrolment growth, enhancing the labs are required. Kansas universities are competing for the same pool of applicants. If WSU has to be competitive against K-State and University of Kansas, we have to set up labs that are at par with other universities. We also ha

Strengths:

1. Most undergraduate students gain coop/internship experience.
2. The faculty is diverse with respect to research and teaching.
3. Students have ready access to faculty.
4. There are five very active student professional organizations supported by the department.
5. The department has a relatively large graduate program.
6. There is a positive collegial atmosphere in the department.
7. BSIE undergraduate student has experience with two industry-based capstone design projects.

8. All senior design projects are industry based.
9. The faculty are very productive in terms of research, publication, funding, and service.
10. The department has seen growth in the number of undergraduate students.
11. As manufacturing becomes more sophisticated in local industry, the demand for industrial and manufacturing engineering graduates has increased.
12. The department has worked with the business school to develop a new inter-disciplinary MS program in Global Supply Chain Management.
13. The department has signed several 2+2 agreements with community colleges – (Cowley County, Butler County).

Weakness:

1. Not enough financial support for PhD students for long term planning and recruitment.
2. There is a significant shortage of both teaching and research laboratory space.
3. Operating expenses and lack of GTA funding may impact the quality of course delivery.

Opportunities:

1. Badge courses have been started to increase enrollment. There are opportunities for strengthening these and increasing enrollment.
2. Both manufacturing and service organizations are implementing continuous improvement strategies which may make use of faculty research capabilities.
3. The department is currently working on 2+2 agreements with the following community colleges – Johnson County, Metropolitan, and Hutchinson. Agreements are also being planned with Kansas-Wesleyan. All of these agreements are expected to be by June, 2018.

Threats:

1. The growth of the department's programs may be limited by a lack of teaching and research laboratory space.
2. Low faculty salaries are causing issues in retention of faculty (especially productive ones)
3. The plan by graduate school to not fund the out-of-state tuition waivers may lead to enrolmment reduction.

Plan/Goals

1. Develop hybrid online courses for Engineering management.
2. Continue to increase lab and problem based learning will be a significant component of the pedagogical approach employed by the department
3. Continue to increase research funding for the departments.